Onsite Sewage Disposal Of High Strength Wastewater

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High Strength Waste

- A. What is it?
- B. Where is it found?
- C. How do you deal with it?

Purpose of an OSDS

- Treat and dispose of domestic wastewater from a residential or commercial facility.

- Ideally, an on-site sewage disposal system will perform adequately for a long period of time, so long as it is not overloaded hydraulically or **organically**.

Problem with Onsite Disposal of High Strength Wastewater

• The design, operation and maintenance of an OSDS is based on **assumptions** about the wastewater:

1. Volume of Wastewater
2. Quality of Wastewater

• The ability of an OSDS to effectively treat and safely dispose of effluent is affected by these factors.

Parameters Used to Evaluate the Quality of Effluent : Clogging Factors

- 1. **BOD_5 -** Measures oxygen required for biochemical degradation of organic & inorganic material.
- 2. **COD -** Measures oxygen equivalent of the organic content of a sample; samples from a specific source can be related to BOD_5.

Parameters Used to Evaluate the Potential for Clogging (continued):

- 3. **TSS -** Total Suspended Solids are a constituent of total solids. It is residue retained on a filter after drying the sample and is a measure of the level of treatment being achieved.
- Can be inorganic particles, which are difficult for biological processes to break down, resulting in mechanical clogging.

More Parameters used to Evaluate the Potential for Clogging:

- 4. **Fats, Oil, and Grease (FOG) -** Measures biological lipids and mineral hydrocarbons.
- The analytical test does not measure an absolute quantity, but is useful in making comparisons of wastewaters.

Parameters Used to Evaluate the Quality of Effluent: Nutrients

- 5. **Nitrogen** **-** Of concern due to its impact on groundwater and surface waters.
- Its form can change as it moves through a treatment system and into the receiving environment.
- Acts as a potentially limiting nutrient for photosynthetic autotrophs in surface waters, and as a potential health risk in groundwater

Parameters used to Evaluate Effluent Quality – Nitrogen (continued):

- Total Nitrogen consists of:

  A. Nitrate (NO_3)

  B. Nitrite (NO_2) and

  C. Total Kjeldahl Nitrogen (TKN) (which consists of)

    1. Ammonia (NH_3) &
    2. Organic Nitrogen

Parameters used to Evaluate Effluent Quality - Nutrients

- 5. **<u>Phosphorous</u> -** In wastewater, occurs almost entirely as phosphates.
- Is formed primarily by biological processes on substances contributed by body wastes and food residues.
- Like Nitrogen, a potentially limiting nutrient in surface waters.

Residential vs. Commercial Wastewater Characteristics

Residential Wastewater:

- Quality tends to be less variable than commercial over time.
- In an OSDS, fluctuations in strength and duration of pollutant-generation tend to be dampened by a sedimentation (septic) tank

Residential vs. Commercial Wastewater Characteristics

Commercial Wastewater:

- Quality tends to be more variable in its quality than from a "typical" residence.

Potential Harm to an OSDS Receiving High Strength W/W

1. High BOD_5:

- Increased biological demand on downstream component.
- May shorten life of the OSDS

2. High TSS:

- Inorganics are less easily broken down.
- Can accelerate mechanical clogging of infiltrative surface.

Potential Harm to an OSDS Receiving High Strength W/W

- **3. High Fats, Oils and Grease (FOG)-**
- Highly increased biological demand on downstream components.
- May drastically shorten life of the OSDS.
- Most difficult constituent to control.

Effects of High Strength Wastewater

Commercial Wastewater Characteristics

•Many generate wastewater similar to residential units; However….

•<u>Some</u> generate high strength wastewater:

- -Restaurants
- -Carry-Outs (pizza parlors, sub shops)
- -Medical Facilities
- -Food Processing plants, Slaughterhouses

Residential Septic Tank Effluent Quality

	BOD5	COD	TSS	TKN	NO3	TP	FOG
MEAN	163	203	81	38	<0.2	6.7	*
MEDIAN	162	169	41	36	<0.2	6.8	
MIN.	32	99	3	16	<0.2	4.5	
MAX.	435	436	720	69	0.2	9.4	
#of Samples	28	12	28	28	4	13	
"TYPICAL"	140 mg/l		75 mg/l				15 mg/l

(samples collected from 9 Md. sites with 2-compartment septic tanks)

Commercial Septic Tank Effluent Quality

	BOD5	COD	TSS	TKN	NO3	TP	FOG
MEAN	888	1206	132	69	<0.2	18.5	182
MEDIAN	626	1090	90	60	<0.2	---	67
MIN.	155	170	10	29	<0.2	16.9	13
MAX.	2951	2888	642	127	1.4	20	814
#of Samples	26	27	27	26	15	2	8

All Sample Results are in milligrams per liter (mg/l)

(Samples collected from 13 sites in Maryland)

Septic Tank Effluent Quality:

Comparison of Means

Parameter*	Residential	Commercial	Factor
BOD_5	163	888	545%
COD	203	1206	594%
TSS	81	132	163%
TKN	38	69	182%
NO3	<0.2	<0.2	-----
TP	6.7	18.5	276%
FOG	15	182	1213%

* mg/l

Calculation of Nutrient Loading to an OSDS

LBS. Of BOD_5 = Flow (GPD) x BOD_5 (mg/l) x C (.00000834)

(Residential) 300gpd x 163mg/l x C = 0.41 lbs per day

0.41LBS/Day / 250 sq.ft. = 0.00164 lbs. per sq. ft. per day

(Commercial 1) 350gpd x 1,117 mg/l x C = 3.26 lbs. per day

3.26 lbs./day / 250 sq.ft. = 0.013 lbs per sq. ft. per day (~8x)

(Commercial 2) 3000 gpd x 733 mg/l x C = 18.34 lbs./day BOD

18.34 lbs. per day / 16,200 sq.ft.* = 0.0011 lbs. per sq.ft. per day

* low hydraulic loading rate (0.19 gpd/sq.ft.) still results in ponding

Options for Dealing With High Strength Wastewaters

- A. Control at the Source.
- B. Treat to a Higher Level Before Discharge.
- C. Adjust Loading Rates According to Strength of the Wastewater.

A. Control at the Source

1. Minimize or remove those constituents of the waste load which cause the high strength waste.

2. Treat the waste <u>before</u> it leaves the facility.

B. Treat to a Higher Level

1. Install a proprietary advanced treatment unit (trickling filter, aeration unit).

2. Install a media (i.e., sand, gravel, glass) filter (intermittent, recirculating).

C. Adjust Loading Rates

1. Use <u>Pounds of BOD_5</u> per day/sq.ft. (instead of gallons)

- Effectiveness depends upon which constituent is the major problem. (Oil and grease are very problematic).
- Appears to be the least effective strategy.

Conclusion

- To adequately design an onsite sewage disposal system, you need to know the anticipated volume **and strength** of the wastewater.

CASE STUDY

Restaurant with failing OSDS

High Flows: 2880 gpd
(weekend avg.)

High Strength Wastewater
1200 mg/l BOD
450 mg/l TSS
124 mg/l FOG

Limited Area for Repair
(trench loading = 0.9gpd/ft^2

Soil Limitations

Improved Kitchen Practices to <u>Attempt to Control FOG</u>

- Scrape plates and cookware before rinsing.
- Reduce surge flows through water conservation measures.
- Use low temperature sanitizing rinse dishwashers.
- Use dishwashing and general cleaning agents that promote oil & water separation.

Improved Kitchen Practices to Attempt to Control FOG

- Use proper concentrations of solvents and cleaners (some cleansers can emulsify grease).
- Use proper concentrations of disinfectants (excess use reduces bacterial action in septic system).
- Use shortening in place of vegetable oil.

GREASE TANK SIZING

Source: Northwest Cascade - Stuth

How big is big enough? That's the question NCS sought to answer in a study of six restaurant sites with grease tanks sized from less than a half-day average flow to more than seven days average retention time.[2] The answer may surprise many of you. We found that after two days retention time there was limited value to adding more grease tank capacity. Kitchen habits appear to have the greatest impact on grease tank effectiveness. With increased use of vegetable oils, which tend to remain emulsified, and chemical washes and degreasers, which further emulsify fats, oils and grease, there is a limit to what grease tanks can remove.

Following is a summary of study results:

	Retention Time (Days)	pH	FOG (mg/L)
Restaurant #1	0.4	3.94	12,802
Restaurant #2	0.7	4.57	1,270
Restaurant #3	2.6	4.97	193
Restaurant #4	2.8	4.46	323
Restaurant #5	3.9	4.04	395
Restaurant #6	7.2	4.75	2,487

Based on this study conducted in Washington State and our experience across the rest of the country, NCS sizes grease tanks using a design standard of the greatest between two days average flow and one and a half days peak flow, whichever is higher.

2 For a complete copy of this study regarding the performance of grease tanks, give us a call or email your request.

Existing grease trap is only 1000 gallon capacity. An effluent filter was installed on the outlet baffle to facilitate grease retention.

Table 1. Typical wastewater effluent composition and loading rates.

Effluent Type	Typical Concentrations[1] BOD5	TKN	tBOD[2]	TSS	Mass Loadings Flow	BOD5	TKN	tBOD	TSS
	mg/L				cm/d	g/m²/d			
Restaurant STE	500	65	1300	180	1	5.0	0.65	13.0	1.8
Domestic STE	150	55	550	80	1	1.5	0.55	5.5	0.8
Graywater STE	150	15	370	40	1	1.5	0.15	3.7	0.4
Domestic Aerobic Unit	35	10	115	40	1	0.35	0.10	1.15	0.4
Domestic Sand Filter	5	2	19	10	1	0.05	0.02	0.19	0.10
Restaurant STE	500	65	1300	180	5	25.0	3.25	65.0	9.0
Domestic STE	150	55	550	80	5	7.5	2.75	27.5	4.0
Graywater STE	150	15	370	40	5	7.5	0.75	18.5	2.0
Domestic Aerobic Unit	35	10	116	40	5	1.75	0.5	5.8	2.0
Domestic Sand Filter	5	2	19	10	5	0.25	0.1	0.95	0.50

[1] Based on data reported by Siegrist and Boyle, 1982; Siegrist et al., 1985; 1986; Ronayne et al., 1982; SSWMP, 1978; Minor, 1985; and Effert et al., 1985.

[2] tBOD = ultimate carbonaceous BOD ($cBOD_L$) plus nitrogenous BOD with $cBOD_L$ based on BOD_5 and K_{10} = 0.06 days^{-1} and nBOD = 4.57 * TKN.

Pretreating to reduce BOD, TSS and FOG can allow higher loading rates.

Aerobic Pretreatment

More complex controls and increased maintenance required.

Irrigation Control Valve Facilitates Uniform Distribution

Characterize soil

Determine flow and effluent quality

Determine treatment requirement

Determine trench loading rate

Maximize design

Incorporate maintenance

Managing High Strength Wastewater

Pretreatment

Controls

Maintenance

Uniform Distribution